

## CLAIMS:

**1. A vehicular steering control apparatus, characterized by comprising:**  
a steering input unit that is operated by a driver;  
an automatic steering unit that automatically steers steerable wheels relative to  
the steering input unit; and

    a steering assist force generation unit that generates a steering assist force,  
wherein

    steering control performed by at least one of the automatic steering unit and the  
steering assist force generation unit is so changed as to damp fluctuations in an operational  
force required of the driver which result from inversion of an actual turning direction of the  
steerable wheels, if it is determined that the turning direction is inverted through the  
automatic steering.

**2. The vehicular steering control apparatus according to claim 1, wherein**  
a steering torque is detected,  
a target steering assist force is calculated on the basis of the steering torque, and  
the steering assist force generation unit is controlled at least on the basis of the  
target steering assist force.

**3. The vehicular steering control apparatus according to claim 1 or 2,**  
wherein

    a running state of a vehicle is estimated,  
    a target automatic steering amount for stabilizing the running state of the vehicle  
by turning the steerable wheels is calculated if the running state of the vehicle is unstable,  
and  
    the automatic steering unit is controlled at least on the basis of the target  
automatic steering amount.

**4. The vehicular steering control apparatus according to any one of claims 1  
to 3, wherein**

    a steering assist force generated by the steering assist force generation unit is  
increased in comparison with a case where an actual turning direction of the steerable  
wheels that are turned through the automatic steering is not inverted, if it is determined that

the turning direction is inverted.

**5. The vehicular steering control apparatus according to claim 4, wherein**  
an inversion time zone in which the turning direction is inverted is estimated,  
and

a steering assist force generated by the steering assist force generation unit is  
increased in the inversion time zone.

**6. The vehicular steering control apparatus according to claim 5, wherein**  
the inversion time zone is estimated as a time zone including a period around a  
time when the turning direction is actually inverted.

**7. The vehicular steering control apparatus according to claim 5 or 6,**  
**wherein**

a time when an operational speed of the steering input unit and a turning speed  
of the steerable wheels that are turned through automatic steering are equal in magnitude  
and opposed in sign on the assumption that either a left-turn direction or a right-turn  
direction is a positive direction is estimated as the time when the turning direction is  
actually inverted.

**8. The vehicular steering control apparatus according to any one of claims 5**  
**to 7, wherein**

a steering assist force generated by the steering assist force generation unit is  
increased by detecting a steering torque and calculating a target steering assist force such  
that a ratio of the target steering assist force to a steering torque becomes larger in the  
inversion time zone than during a normal state.

**9. The vehicular steering control apparatus according to any one of claims 5**  
**to 8, wherein**

a running state of the vehicle is estimated,  
a target automatic steering amount for stabilizing the running state of the vehicle  
by turning the steerable wheels is calculated if the degree of instability in the running state  
of the vehicle is high,  
the automatic steering unit is controlled at least on the basis of the target

automatic steering amount,

a change in the target automatic steering amount is predicted, and

an inversion time zone is estimated on the basis of the predicted change in the target automatic steering amount and an actual change in the target automatic steering amount.

**10. The vehicular steering control apparatus according to any one of claims 1 to 3, wherein**

an automatic steering amount of the steerable wheels that are steered by the automatic steering unit is reduced so as to prevent an actual turning direction of the steerable wheels that are turned through the automatic steering from being inverted, if it is determined that the turning direction is being inverted.

**11. The vehicular steering control apparatus according to claim 10, wherein**

an amount of reduction of an automatic steering amount of the steerable wheels that are steered by the automatic steering unit is reduced in comparison with a case where the degree of instability in the running state of the vehicle is low, if the degree of instability in the running state of the vehicle is high.

**12. The vehicular steering control apparatus according to claim 10, wherein**

the automatic steering amount of the steerable wheels that are steered by the automatic steering unit is not reduced if the degree of instability in the running state of the vehicle is high.

**13. The vehicular steering control apparatus according to claim 1, wherein**

a running state of the vehicle is estimated,

a target automatic steering amount for stabilizing the running state of the vehicle by turning the steerable wheels is calculated if the degree of instability in the running state of the vehicle is high,

the automatic steering unit is controlled at least on the basis of the target automatic steering amount, and

a determination is made on a situation in which an actual turning direction of the steerable wheels that are turned through automatic steering is inverted, on the basis of a relationship between a sign of a change rate of a steering operation amount and a sign of a

sum of a change rate of the steering operation amount and a change rate of the target automatic steering amount.

**14. The vehicular steering control apparatus according to claim 1, wherein**  
an automatic steering amount of the steerable wheels that are steered by the automatic steering unit is reduced by estimating a running state of the vehicle, calculating a target automatic steering amount for stabilizing the running state of the vehicle by turning the steerable wheels if the degree of instability in the running state of the vehicle is high, calculating a change rate of the target automatic steering amount on the basis of the target automatic steering amount, controlling the automatic steering unit at least on the basis of the change rate of the target automatic steering amount, and reducing the change rate of the target automatic steering amount.

**15. The vehicular steering control apparatus according to claim 14, wherein**  
the change rate of the target automatic steering amount is reduced to a value that does not allow the steerable wheels to be turned.

**16. A vehicular steering control apparatus, comprising:**  
a steering input unit that is operated by a driver;  
an automatic steering unit that automatically steers steerable wheels relative to the steering input unit;  
a steering assist force generation unit that generates a steering assist force; and  
a controller that determines whether or not an actual turning direction is inverted through the automatic steering, and changes steering control performed by at least one of the automatic steering unit and the steering assist force generation unit in such a manner as to damp fluctuations in an operational force required of the driver which result from inversion of the turning direction of the steerable wheels, if it is determined that the turning direction is inverted through the automatic steering.

**17. The vehicular steering control apparatus according to claim 16, wherein**  
the controller increases a steering assist force generated by the steering assist force generation unit in comparison with a case where an actual turning direction of the steerable wheels that are turned through the automatic steering is not inverted, if it is determined that the turning direction is inverted.

**18. The vehicular steering control apparatus according to claim 16, wherein the controller reduces an automatic steering amount of the steerable wheels that are steered by the automatic steering unit so as to prevent an actual turning direction of the steerable wheels that are turned through the automatic steering from being inverted, if it is determined that the turning direction is being inverted.**

**19. The vehicular steering control apparatus according to claim 18, wherein the automatic steering unit automatically steers the steerable wheels so as to stabilize a running state of the vehicle, and the controller reduces an amount of reduction of an automatic steering amount of the steerable wheels that are steered by the automatic steering unit in comparison with a case where the degree of instability in the running state of the vehicle is low, if the degree of instability in the running state of the vehicle is high.**